Claims

1.   A method for allocation of an available power budget to Discrete Multi-Tone (DMT) frequency tones in a DMT-based Digital Subscriber Line (DSL) modem, comprising the steps of:

5   initializing the DMT-based DSL modem by calculating aggregate values of channel attenuation, noise power, and power mask;

pre-filtering to flag noisy bins that are unable to support a minimum number of bits with a maximum power available for transmission in a bin; and

using a repeated-bisection splitting scheme to allocate the available power

10   substantially optimally among a plurality of bands for DMT frequency tones, and

where bins flagged by the pre-filtering step remain unexcluded, said scheme excludes the bins flagged in the pre-filtering step.

2.   The method of claim 1 wherein the repeated-bisection splitting scheme includes the steps of:

15   splitting the available power optimally between the lower and the upper halves of a 1.104-MHz bandwidth to form two power fractions for two substantially 552 KHz wide bands;

splitting each of the two power fractions substantially optimally between two halves of each of the substantially 552 KHz wide bands to form four power fractions for four substantially 276 KHz wide bands;

20   splitting each of the four power fractions optimally between two halves of each of the four substantially 276 KHz wide bands to form eight power fractions for eight substantially 138 KHz wide bands;

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splitting each of the eight power fractions optimally between two halves of each of the eight substantially 138 KHz wide bands to form sixteen power fractions for sixteen substantially 69 KHz wide bands;

splitting each of the sixteen power fractions optimally between two halves of each of

5   the sixteen substantially 69 KHz wide bands to form thirty-two power fractions for thirty-two substantially 34.5 KHz wide bands;

splitting each of the thirty-two power fractions optimally between two halves of each of the thirty-two substantially 34.5 KHz wide bands to form sixty-four power fractions for sixty-four substantially 17.25 KHz wide bands;

10   splitting each of the sixty-four power fractions optimally between two halves of each of the sixty-four 17.25 KHz wide bands to form one hundred twenty eight power fractions for one hundred twenty eight substantially 8.625 KHz wide bands; and

splitting each of the one hundred twenty eight power fractions optimally between two halves of each of the one hundred twenty eight, 8.625 KHz wide bands to form two

15   hundred fifty six power fractions to form two hundred fifty six substantially 4.3125 KHz wide bands.

3.   The method of claim 2 wherein the initializing step of claim 1 provides for calculating aggregate parameters needed for the steps of claim 2 while excluding noisy bins that are flagged as unable to support a minimum number of bits with a maximum power available for

20   transmission in a bin.

4.   The method of claim 3 wherein each of 2^j elements of a noise power vector to be used at step-j is calculated as a sum of noise power values in bins aggregated for the step-j, where

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$j = 1, \ldots, 8$.

5. The method of claim 3 wherein each of 2^j elements of a channel attenuation vector that is to be used at step-j is calculated as an average of channel attenuation values in bins aggregated for step-j, where $j = 1, \ldots, 8$.

6. The method of claim 3 wherein each of 2^j elements of a power mask vector that is to be used at step-j is calculated as a sum of power mask values in bins aggregated for step-j, where j $= 1, \ldots, 8$.

7. The method of claim 1 wherein the available power is allocated to 2^n tones where n is a preselected integer.

8. The method of claim 7 wherein initializing includes calculating aggregate parameter values of channel attenuation, noise power, and power mask for n subsequent steps.

9. An apparatus for allocating an available power to a plurality of Discrete Multi-Tone (DMT) frequency tones using a repeated-bisection of power scheme to partition the available power over the plurality of DMT frequency tones in a DMT-based Digital Subscriber Line (DSL) modem, comprising:

an initialization unit, for initializing the DMT-based DSL modem by calculating aggregate parameter values of channel attenuation, noise power, and power mask;

a pre-filtering unit, coupled to the initialization unit, for pre-filtering to flag noisy bins that are unable to support a minimum number of bits with a maximum power available for transmission in a bin; and

a repeated-bisection power splitting and allocation unit, coupled to the pre-filtering

unit, for using the repeated-bisection of power scheme to allocate available power

substantially optimally among a plurality of bands for DMT frequency tones.

10.   The apparatus of claim 9 wherein the repeated-bisection splitting unit implements the

5   repeated-bisection of power scheme by:

splitting the available power optimally between the lower and the upper halves of a

1.104-MHz bandwidth to form two power fractions for two substantially 552 KHz wide bands;

splitting each of the two power fractions substantially optimally between two halves

of each of the substantially 552 KHz wide bands to form four power fractions for four

10   substantially 276 KHz wide bands;

splitting each of the four power fractions optimally between two halves of each of

the four substantially 276 KHz wide bands to form eight power fractions for eight substantially

138 KHz wide bands;

splitting each of the eight power fractions optimally between two halves of each of

15   the eight substantially 138 KHz wide bands to form sixteen power fractions for sixteen

substantially 69 KHz wide bands;

splitting each of the sixteen power fractions optimally between two halves of each of

the sixteen substantially 69 KHz wide bands to form thirty-two power fractions for thirty-two

substantially 34.5 KHz wide bands;

20   splitting each of the thirty-two power fractions optimally between two halves of each

of the thirty-two substantially 34.5 KHz wide bands to form sixty-four power fractions for

sixty-four substantially 17.25 KHz wide bands;

splitting each of the sixty-four power fractions optimally between two halves of each of the sixty-four 17.25 KHz wide bands to form one hundred twenty eight power fractions for one hundred twenty eight substantially 8.625 KHz wide bands; and

splitting each of the one hundred twenty eight power fractions optimally between

5   two halves of each of the one hundred twenty eight, 8.625 KHz wide bands to form two hundred fifty six power fractions to form two hundred fifty six substantially 4.3125 KHz wide bands.

11.   The apparatus of claim 9 wherein the initialization unit is further coupled to the pre-filtering unit to receive notification of the bins that are flagged, calculates aggregate parameter

10   values needed to implement the repeated-bisection of power scheme and excludes bins flagged by the pre-filtering unit.

12.   The apparatus of claim 9 wherein each of 2^j elements of a noise power vector to be used at step-j of the repeated-bisection of power scheme is calculated as a sum of noise power values in bins aggregated for the step-j, where j $=1,...,8$.

15   13.   The apparatus of claim 9 wherein each of 2^j elements of a channel attenuation vector that is to be used at step-j of the repeated-bisection of power scheme is calculated as an average of channel attenuation values in bins aggregated for step-j, where j $=1,...,8$.

14.   The apparatus of claim 9 wherein each of 2^j elements of a power mask vector that is to be used at step-j of the repeated-bisection of power scheme is calculated as a sum of power

20   mask values in bins aggregated for step-j, where j $=1,...,8$.

15.   The apparatus of claim 9 wherein the available power is allocated to 2^n tones where n is a preselected integer.

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16.   The apparatus of claim 9 wherein the initialization unit initializes the modem by calculating aggregate parameter values of channel attenuation, noise power, and power mask for *n* subsequent steps.

17.   Computer readable medium having computer-executable instructions for allocation of an

5   available power to Discrete Multi-Tone (DMT) frequency tones in a DMT-based Digital Subscriber Line (DSL) modem, wherein the computer-executable instructions comprise the steps of:

      initializing the modem by calculating aggregate values of channel attenuation, noise power, and power mask;

10   pre-filtering to flag noisy bins that are unable to support a minimum number of bits with a maximum power available for transmission in a bin; and

      using a repeated-bisection splitting scheme to allocate the available power substantially optimally among a plurality of bands for DMT frequency tones.

18.   The computer readable medium of claim 17 wherein the repeated-bisection splitting

15   scheme includes the steps of:

      splitting the available power optimally between the lower and the upper halves of a 1.104-MHz bandwidth to form two power fractions for two substantially 552 KHz wide bands;

      splitting each of the two power fractions substantially optimally between two halves of each of the substantially 552 KHz wide bands to form four power fractions for four

20   substantially 276 KHz wide bands;

splitting each of the four power fractions optimally between two halves of each of the four substantially 276 KHz wide bands to form eight power fractions for eight substantially 138 KHz wide bands;

splitting each of the eight power fractions optimally between two halves of each of

5   the eight substantially 138 KHz wide bands to form sixteen power fractions for sixteen substantially 69 KHz wide bands;

splitting each of the sixteen power fractions optimally between two halves of each of the sixteen substantially 69 KHz wide bands to form thirty-two power fractions for thirty-two substantially 34.5 KHz wide bands;

10   splitting each of the thirty-two power fractions optimally between two halves of each of the thirty-two substantially 34.5 KHz wide bands to form sixty-four power fractions for sixty-four substantially 17.25 KHz wide bands;

splitting each of the sixty-four power fractions optimally between two halves of each of the sixty-four 17.25 KHz wide bands to form one hundred twenty eight power fractions for

15   one hundred twenty eight substantially 8.625 KHz wide bands; and

splitting each of the one hundred twenty eight power fractions optimally between two halves of each of the one hundred twenty eight, 8.625 KHz wide bands to form two hundred fifty six power fractions for two hundred fifty six substantially 4.3125 KHz wide bands.

20   19.   The computer readable medium of claim 17 wherein the computer-executable step of initializing includes calculating, for bins unexcluded by pre-filtering flagging, aggregate parameter values needed for the steps of claim 18.

20. The computer readable medium of claim 17 wherein each of 2^j elements of a noise power vector to be used at step-j of the repeated-bisection splitting scheme is calculated as a sum of noise power values in bins aggregated for the step-j, where j =1,…,8.

21. The computer readable medium of claim 17 wherein each of 2^j elements of a channel attenuation vector that is to be used at step-j of the repeated-bisection splitting scheme is calculated as an average of channel attenuation values in bins aggregated for step-j, where j =1,…,8.

22. The computer readable medium of claim 17 wherein each of 2^j elements of a power mask vector that is to be used at step-j of the repeated-bisection splitting scheme is calculated as a sum of power mask values in bins aggregated for step-j, where j =1,…,8.

23. The computer readable medium of claim 17 wherein the available power is allocated to 2^n tones where n is a preselected integer.

24. The computer readable medium of claim 17 wherein initializing includes calculating aggregate parameter values of channel attenuation, noise power, and power mask for n subsequent steps.

25. A modem having an apparatus for allocating an available power to a plurality of Discrete Multi-Tone (DMT) frequency tones using a repeated-bisection of power scheme to partition the available power over the plurality of DMT frequency tones in a DMT-based Digital Subscriber Line (DSL) modem, the apparatus comprising:

an initialization unit, for initializing the DMT-based DSL modem by calculating aggregate parameter values of channel attenuation, noise power, and power mask;

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a pre-filtering unit, coupled to the initialization unit, for pre-filtering to flag noisy

bins that are unable to support a minimum number of bits with a maximum power available

for transmission in a bin; and

a repeated-bisection power splitting and allocation unit, coupled to the pre-filtering

5   unit, for using the repeated-bisection of power scheme to allocate available power

substantially optimally among a plurality of bands for DMT frequency tones.